

Response to First Office Action
Docket No. 028.0371.US.U TTL

REMARKS

Claims 1-7 are pending. No claim has been amended. Claims 1-7 remain in the application.

- Claims 1-7 stand rejected under 35 U.S.C. 103(a) as being obvious over
5 U.S. Patent No. 6,296,757, issued to Wittenbrink, et al., in view of U.S. Patent No. 6,369,286, issued to O'Rear or U.S. Patent No. 4,460,710, issued to Sapienza. Applicant traverses the rejection.

- To establish a *prima facie* case of obviousness: (1) there must be some suggestion or motivation, either in the references themselves or in the knowledge
10 generally available to one of ordinary skill in the art, to modify the reference or combine the reference teachings; (2) there must be a reasonable expectation of success; and (3) the combined references must teach or suggest all the claim limitations. MPEP § 2143. A *prima facie* case of obviousness has not been shown per Claims 1-7.

- 15 Wittenbrink discloses a process to produce diesel fuel from non-shifting Fischer-Tropsch (FT) process by separating the FT product into lighter and heavier fractions, subjecting the heavier fraction to hydro-treating, and combining the lighter ends of hydro-treated product with the lighter fraction that has not been hydro-treated (Abstract). Specifically, synthesis gas, hydrogen and carbon
20 monoxide, in a specified ratio is fed into an FT reactor, and product is recovered as 700°F+ and 700°F- fractions (Col. 2, lines 17-21). The heavier fraction, that is the 700°F+ fraction, is sent to a hydro-isomerization unit, where olefins and oxygen containing materials are hydrogenated (Col. 2, lines 30-34). The hydro-isomerization product is then recovered, into which the C5-700°F streams are
25 blended, which is subsequently fractionated in a tower (Col. 3, lines 36-40). The preferred FT process utilizes a non-shifting catalyst, such as cobalt or ruthenium or mixtures thereof, preferably zirconium or rhenium promoted cobalt (Col. 4, lines 5-10).

- O'Rear discloses a process for preparing distillate fuel compositions from
30 a C₂₋₆ olefinic fraction and a C₂₀₊ fraction via molecular averaging (Abstract). The fractions used can be obtained from FT reactions or other processing of crude

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oil (Abstract). Specifically, hydrocarbons in the distillate fuel range from an FT reaction are first isolated. Then, the wax or heavy fractions are dehydrogenated, the naphtha or light gas fractions are added to the resulting olefinic mixture, and reaction mixture is molecularly averaged by subjecting the olefins to olefin
5 metathesis conditions.

Sapienza discloses a method for improving catalyst stability in air by heating a heterogeneous component of the palladium or platinum deposited on the solid support in a solution of cobalt carbonyl or precursors thereof (Abstract). The disclosed catalyst composed of palladium or platinum and cobalt supported
10 on a solid phase (Col. 2, lines 29-32). The disclosed catalyst can be used to product a fraction of linear hydrocarbons ranging from C₁ to C₄₀ with a low degree of branching (Col. 2, lines 12-15). The produced diesel fuel typically contains a broad distribution of C₁ to C₄₀ paraffins (Col. 6, lines 50-55, Figure 7).

In contrast, Claim 1 defines a method for converting directly synthesis gas
15 to hydrocarbons with high diesel distillates content through an FT process. The synthetic fuels with diesel distillates as primary products are produced through a one-step synthesis technique from synthesis gas, where the synthesis gas is composed of hydrogen and carbon monoxide with the mole ratio of hydrogen to carbon monoxide within the range of 1 to 4. For the FT process, activated carbon
20 supported cobalt based catalysts are employed, and the synthesis conditions comprise reaction temperature within the range of 120 to 400°C, reaction pressure within the range of 0.5 to 10.0 MPa, volume hourly space velocity of mixture of hydrogen and carbon monoxide within the range of 100 to 5000.

Wittenbrink does not teach or suggest an FT process where diesel fuels
25 can be produced in one step without hydro-treating. Instead, Wittenbrink teaches a process where the products of the FT reaction include both a heavy fraction and light fraction, and the heavy fraction is subsequently hydro-treated via hydro-isomerization. The final product, diesel fuels, are then produced by blending the light fractions with the hydro-treated heavy fraction. Consequently, Wittenbrink
30 teaches away by defining a process that derives desired distribution of diesel fuel through hydro-treating, as opposed to a simplified one-step process.

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O'Rear does not teach or suggest using activated carbon supported cobalt catalyst in an FT process. Rather, O'Rear discloses the catalyst used for olefin metathesis to treat products from an FT process. The feeds for the disclosed invention is not synthetic gases but instead fractions of C₂-C₆ olefin and C₂₀+
5 fractions. Therefore, O'Rear also teaches away by disclosing a catalyst not used for FT processes but for olefin metathesis.

Sapienza does not teach or suggest that using activated carbon as the carrier of the cobalt catalyst can alter the distribution of the FT product so as to directly prepare clean diesel fuel from synthetic gas. Instead, Sapienza mainly
10 attempts to improve the activity and stability of the catalyst and to produce a product composed of a fraction of linear hydrocarbons ranging from C₁ to C₄₀ with a low degree of branching. Moreover, Sapienza teaches a catalyst composed of palladium or platinum and cobalt. Thus, Sapienza also teaches away by including a palladium or platinum composition in the disclosed catalyst as an
15 essential ingredient.

In addition, using activated carbon as support for the cobalt catalyst, as recited in Claim 1, has unexpected results. Even though activated carbon has been used as a support for heterogeneous catalyst, using carbon supported cobalt catalysts in an FT process provides high activity and selectivity toward diesel
20 distillates produced by the process and good long term stability of the catalysts. Thus, by using activated carbon supported cobalt based catalysts, synthetic gases can be converted directly into clean diesel fuels with the ratio of diesel and gasoline in liquid FT products up to 60-65%. This distillate fuel can be used directly as diesel without any hydro-treating. One theory for this unexpected
25 result is that the pore size of activated carbon restricts wax formation during the FT process.

The cited references fail to provide a motivation or suggestion to directly convert synthesis gas to hydrocarbons with high diesel distillates content through an FT process using activated carbon supported cobalt based catalysts, as recited
30 in Claim 1. Also, there is no reasonable expectation of success because the cited references fail to teach or suggest a one-step process for producing high quality

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diesel fuels. Moreover, using carbon supported cobalt as catalysts in an FT process has an unexpected result that greatly improves the distribution of diesel and gasoline fractions. Thus, a *prima facie* case of obviousness has not been shown with respect to Claim 1.

5 Claims 2-7 are dependent on Claim 1 and are patentable for the above-stated reasons, and as further distinguished by the limitations recited therein. Accordingly, as a *prima facie* case of obviousness has not been shown for Claims 1-7, withdrawal of the rejection for obviousness under 35 U.S.C. 103(a) is requested.

10 Claims 1-7 are believed to be in condition for allowance. Entry of the foregoing amendments is requested and a Notice of Allowance is earnestly solicited. Please contact the undersigned at (206) 381-3900 regarding any questions or concerns associated with the present matter.

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Respectfully submitted,

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